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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/521,389	03/08/2000	Shigeru Okamoto	1508.63671	9947

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EXAMINER

MALDONADO, JULIO J

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 01/13/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/521,389

Applicant(s)

OKAMOTO, SHIGERU

Examiner

Julio J. Maldonado

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3, 5, 6, 37-43, 48 and 49 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-3, 5, 6, 37-43, 48 and 49 is/are allowed.
- 6) ☐ Claim(s) _____ is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. The cancellation of claims 4, 7, and 44-47 is acknowledged.
2. The rejection of claims 1-3, 5, 6, 37, 40-43, 48 and 49 in paper mailed on 07/08/2003 is withdrawn in order to include a rejection of the above-mentioned claims and of claims 38 and 39.
3. Claims 1-3, 5, 6, 37-43, 48 and 49 are pending in the application.

Claim Objections

4. Claim 3 is objected to because of the following informalities: where claim 3 recites, "...metal nitride..." should recite, "...metal nitride...". Appropriate correction is required.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1-3, 5, 6 and 37-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens (U.S. 5,070,036) in view of Hoshino (U.S. 4,910,169).

In reference to claims 1-3, 5, 6, 40 and 41, Stevens (Fig.1) teaches an interconnecting semiconductor device comprising an opening part (3) formed in an insulating layer (2) on a substrate (1); a barrier layer (6) covering said opening part (3); a metal growth promoting layer (7) formed directly on said barrier layer (6), wherein said metal growth promoting layer comprises titanium nitride containing a lower oxygen

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concentration than said barrier layer (6) and is different from said first material; and an electroconductive layer (8, 9) comprising aluminum embedded in said opening part (3) or said depressed part via said barrier layer (6) and said metal growth promoting layer (7), wherein said electroconductive layer (8, 9) being formed directly on said metal growth promoting layer (7) and wherein said barrier layer (6) and said growth promoting layer (7) comprises a ground layer comprising titanium nitride containing oxygen at a high concentration at a lower part and at a low concentration in the upper part thereof (column 6, line 66 – column 11, line 61).

Stevens fails to teach the embedded electroconductive layer being formed of a Cu layer, an Al layer, or an Al alloy layer having Al as a main component; and selecting the barrier layer from the group consisting of WN_x and TaN_x , wherein x is a variable such that $0 \leq x \leq 1$; . However, Hoshino (Fig.1A) in a related art to the formation of an interconnect structure comprising an opening part (12a) formed in an insulation layer (12) on a substrate (10); a barrier layer (16) formed in said opening part (12a), wherein said barrier layer selected from the group consisting of WN_x and TaN_x , wherein x is a variable such that $0 \leq x \leq 1$; and forming an electroconductive layer (18) comprising copper (column 2, line 65 – column 3, line 18). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Stevens and Hoshino to enable replacing the barrier layer and the conductive layer of Stevens with those of Hoshino because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable materials disclosed in Stevens

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and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

In reference to claims 37-39, the combined teachings of Stevens and Hoshino fail to teach wherein the metal growth promoting layer has a thickness of about 10-20 nm and wherein said barrier layer has a thickness of at least approximately 10 nm. Notwithstanding, it would have been an obvious matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose these particular dimensions because applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using another dimension. Indeed, it has been held that mere dimensional limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984); *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966).

7. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens ('036) in view of Hoshino ('169) as applied to claims 1-3, 5, 6 and 37-41 above, and further in view of Lee (U.S. 5,552,341).

The combined teachings of Stevens and Hoshino fail to disclose the barrier layer comprising TiSiN. However, Lee (Fig.9) teaches an interconnect device including a

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barrier layer comprising TiSiN (column 10, lines 6-24). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Stevens and Hoshino and Lee to enable replacing the barrier layer of Stevens and Hoshino with that of Lee because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable materials disclosed in Stevens and Hoshino and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07, and furthermore because this would improve the step coverage of the metallic interconnect (column 8, lines 13-24).

8. Claims 43, 48 and 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens ('036) in view of Hoshino ('169) as applied to claims 1-3, 5, 6 and 37-41 above, and further in view of Mu et al. (U.S. 5,612,254).

In reference to claim 43, the combined teachings of Stevens and Hoshino fail to disclose a diffusion barrier comprising Al_2O_3 . However, Mu et al. teach an interconnect structure comprising a barrier layer (not shown) comprising aluminum oxide and an electroconductive layer selected from the group comprising copper and aluminum (column 4, lines 38-55). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Stevens and Hoshino with Mu et al. to replace the barrier layer of Stevens and Hoshino according to the teachings of Mu et al. because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable materials disclosed in Stevens and Hoshino and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

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In reference to claims 48 and 49, the combined teachings of Stevens and Hoshino teach wherein the metal growth promoting layer is titanium nitride (Stevens, column 8, lines 2 and 3), wherein said titanium nitride is formed by reactive sputtering (Stevens, column 10, lines 60 – 65). The combined teachings of Stevens and Hoshino fail to teach wherein a chemical vapor deposition process forms said titanium nitride. However, Mu et al. teach forming titanium nitride layers using either sputtering or a chemical vapor deposition process (column 4, lines 42 – 55). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Stevens and Hoshino with the teachings of Mu et al. to enable the titanium nitride of Stevens and Hoshino to be formed according to the teachings of Mu et al. because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of forming the disclosed titanium nitride of Stevens and Hoshino and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Conclusion

Papers related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is **(703) 305-3432**. The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.


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Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Julio J. Maldonado** at **(703) 306-0098** and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via julio.maldonado@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 308-0956**.

gwr

JMR
1/10/04


George Fourson
Primary Examiner